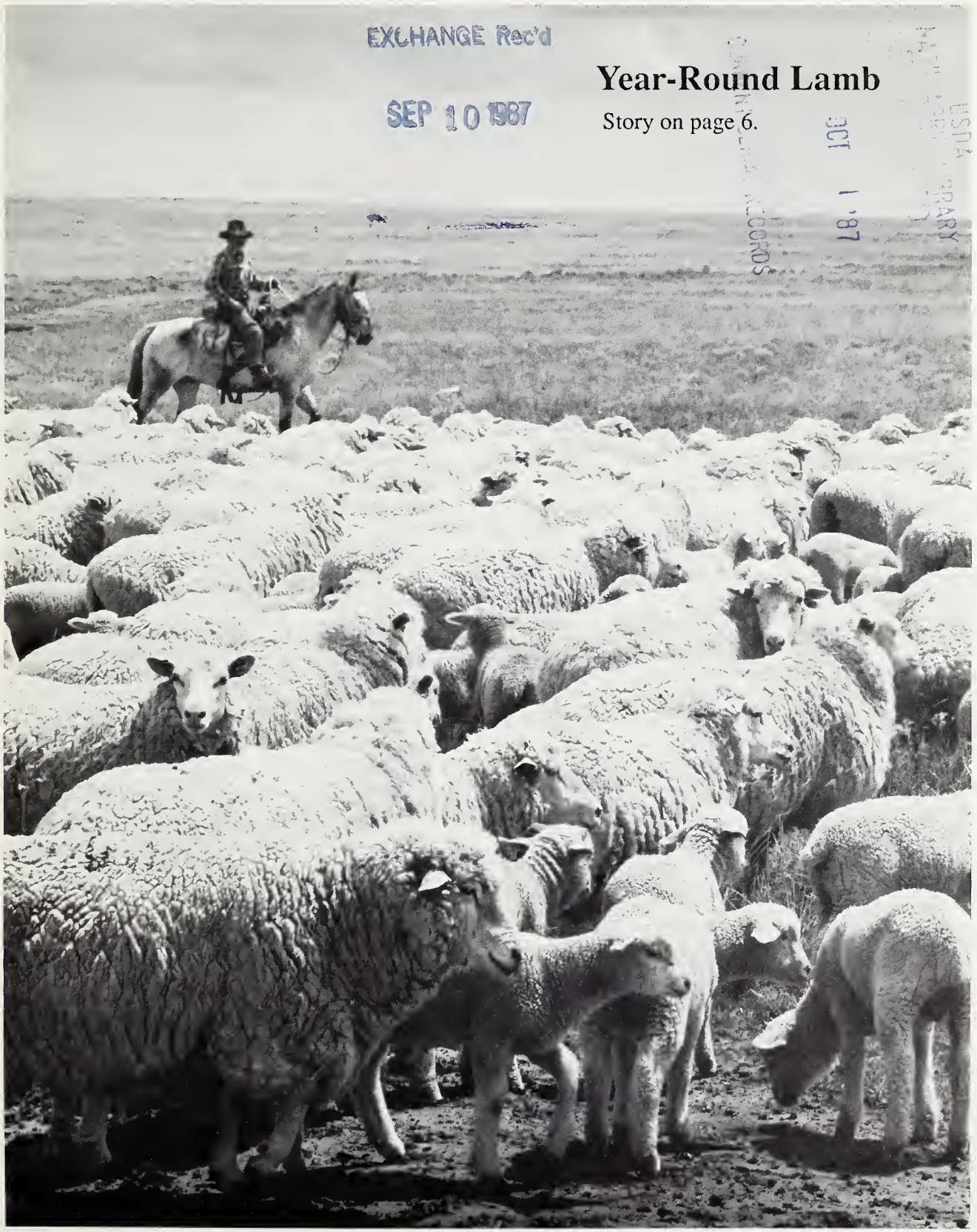
U.S. Department of Agriculture Agricultural Research Service Vol. 35, No. 8, September 1987

Agricultural Research

Year-Round Lamb

Story on page 6.



Needed: More Dialog With Industry

How can agricultural researchers serve their principal client, the farmer, and indirectly, industry—in my case, the farm equipment industry?

The first thing to do to see if a research project is useful is to talk with farmers to make sure the work meets their needs. A farmer may have difficulty in articulating his or her needs in the same terms that a scientist would; the researcher must be willing to listen closely and attempt to visualize how a farmer's problems might best be solved.

Second, researchers should talk more with the farm equipment industry, who will ultimately be responsible for getting the results of equipment research into a customer's hands. While communication is a two-way affair, it is easier for researchers to find key people in industry than for us to locate the right researchers. There are perhaps 10 of us who are responsible for the design of more than 50 percent of the farm implements used today. Yet in the past year, I have been contacted by only two members of the government-university research community for my input on current research directions. We need more dialog than that.

There are many good reasons for research people to talk more with industry—and vice versa. Since it is so vital to our economy today that farming remain profitable, it is crucial that the economic impact of research be explored as fully as possible in the early stages of a project. This is not just a matter of manufacturing feasibility, although that is certainly important. For the farmer, however, the big question about a piece of equipment is "Will it work on my farm?" Let's remember that farmers can select from many different types of equipment and tillage methods today, and it is little wonder that they occasionally get confused and make the wrong decision.

The right kind of research could provide economic and engineering data to help farmers answer the "will it work" question and enable them to make informed choices.

For industry, effective engineering research could provide the design criteria for new and altered machines. Because there are so many tillage practices today and such a variety of soil types, it is difficult for a manufacturer to test a product adequately. If we had a good design base of soil types and conditions, it would help us tremendously to come up with more cost-effective designs.

Most states have several basic soil types; soil scientists know what they are. Research could be conducted on those soils to answer the questions: What is the right tillage practice for this particular soil? What are the right cropping and fertilizer practices? Answering these questions could reduce much of a farmer's uncertainty as well as industry's, and help both make more cost-effective decisions.

Other problem areas where our industry needs better answers include the following:

- **Compaction**—Is it serious enough to worry about it? If vehicles didn't travel over crop rows, would a farmer gain enough to justify the cost of a precision guidance system?
- **Seed spacing**—There is still no consensus on what the most effective seed spacing is.
- **Seed population**—Would there be merit in a planter in which seed population could be changed "on the go" for each soil encountered?
- **Tillage rotation**—In which you not only rotate your crops from year to year, but also your tillage practices. Farmers who do this need more equipment. Research needs to be on the economic aspects of this new approach to farming.
- **Fertilizer placement**—Where, when, and how.
- **Material-handling systems**—With the size of combines and forage equipment available today, we have reached a point where the ability to move material away becomes the limiting factor. If there is one area where a real technical breakthrough is needed, this is it!

These are but a few of the questions in which both farmers and industry need better research answers.

Once research is done, one task remains to make it worthwhile and that is to market the results to the farmer. Frequently, this is where scientific work falls short; findings are not communicated to the people who must apply them. If research programs are to be effective, they must be sold to farmers like any other product.

In summary, if we can make our research focus on those items which can help reduce the farm costs and make sure that the results are communicated to those people who use them, I think that industry can form an effective partnership with research that can yield benefits for all of us. This, in turn, could help build a U.S. farm economy that is profitable and competitive throughout the world for the long term.

Harold J. Schramm
Manager, Implement Engineering,
Case IH, Hinsdale, IL

(Abridged from a recent address to the American Society of Agricultural Engineers.)

Agricultural Research

Cover: From the U.S. Sheep Experiment Station, Dubois, ID, sheep are moved to summer range where plentiful green forage is available. Researchers at the Station are altering sheep's mating patterns to provide consumers with fresh lamb year round. Story on page 6. Photo by Lowell Georgia. (0687X551-32)

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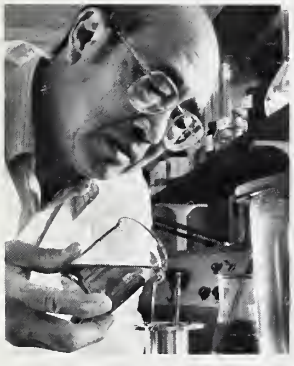

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Vol. 35, No. 8
September 1987

Editor: Lloyd E. McLaughlin
Associate Editor: Regina A. Wiggen
Photography: Robert C. Bjork, Tim McCabe, and Anita Y. Daniels

Agricultural Research is published 10 times per year by the Agricultural Research Service (ARS), U.S. Department of Agriculture, Washington, DC 20250. The Secretary of Agriculture has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Send subscription orders to Superintendent of Documents, Government Printing Office, Washington, DC 20402. Information in this magazine is public property and may be reprinted without permission. Prints of photos are available to mass media; please order by month and photo number.

Magazine inquiries should be addressed to: The Editor, Information Staff, Room 318, Bldg. 005, Beltsville Agricultural Research Center-West, Beltsville, MD 20705. Telephone: (301) 344-3280. When writing to request address changes or deletions, please include a recent address label.

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Exercise May Exorcise Diabetes Risk

Exercise and a carefully chosen diet may not only help us trim pounds but could also reduce the risk of adult-onset diabetes, according to a USDA-Tufts University nutrition researcher.

"As people grow older, body tissues become less sensitive to insulin which the pancreas produces to help metabolize glucose," says William J. Evans, director of the exercise physiology laboratory at USDA's Agricultural Research Service Human Nutrition Research Center on Aging at Tufts in Boston, MA. "The result can be an elevated glucose level that leads to diabetes."

Knowing from detailed studies of athletes that exercise can improve glucose tolerance, Evans is about to launch a 3-year study of exercise and diet—how they may help avoid or even reverse the onset of diabetes.

The study, in cooperation with the National Institutes of Health, will focus on 30 volunteers between the ages of 50 and 75 who are considered at risk of developing the disease.

"Those at risk include men and women who are very inactive physically, who are substantially overweight, or who have a family history of diabetes. They will be divided into three groups that will be assigned to perform very vigorous exercise on a stationary bike; moderate exercise, such as swimming or brisk walking; or weight-training exercise," he said.

"The idea," says Evans, "is to find out what kinds of exercise are most beneficial."

During a second phase of the study, participants will be put on a high-carbohydrate, low-fat diet. This kind of diet is known to counteract impaired insulin sensitivity. It can also reduce the likelihood of diabetes by keeping weight down.

By including a diet component in the study, the Tufts researchers hope to find out whether combining appropriate foods and exercise can markedly reduce the risk of adult-onset diabetes.—By **Theresa Pease**, Tufts University.

William J. Evans is at the USDA-ARS Human Nutrition Research Center on Aging at Tufts University, 711 Washington St., Boston, MA 02111. ♦

Herbicide Resistance Exacts Yield Penalty

Herbicide-resistant crops created by genetic engineering may not be the most profitable ones to plant. Where weed competition is low, a farmer might be better off planting a herbicide-susceptible variety—and then skipping the herbicide application.

For example, varieties of oilseed rape that are crossed with wild mustard to pick up mustard's resistance to weed-killing herbicides may forfeit some growth potential in the process, says an Agricultural Research Service agronomist in Morris, MN.

Frank Forcella discovered this reduction when he test-grew a rape variety that is damaged by a normal exposure to atrazine and an experimental rape line genetically similar except for herbicide resistance. He found that in the absence of both weeds and herbicides, the variety susceptible to damage outyielded the resistant one by about 880 pounds per acre.

Yields were about equal (at 1,930 pounds) in another test where the susceptible rape had to compete with a weed population of 27 wild oat plants per square yard. Herbicide-resistant rape, treated with atrazine, was weed free.

Forcella attributes the herbicide-resistant rape's reduced vigor in these tests to a genetic alteration caused by crossing rape with wild mustard. He says the alteration results in the substitution of a single amino acid in proteins in the chloroplasts (small bodies in plant cells that contain chlorophyll). The modified protein not only elicits atrazine resistance but also retards an energy flow involved in photosynthesis.

Scientists have also observed slower photosynthesis in atrazine-resistant weeds than in nonresistant ones.

Knowing the yield penalty from a herbicide-resistant crop is only part of the picture a farmer needs, Forcella says. An expected level of weed infestation should be weighed against income expected from the crop and the cost of chemical weed control.—By **Ben Hardin,** ARS.

Frank Forcella is at the USDA-ARS North Central Soil Conservation Research Laboratory, Morris, MN 56267. ♦

Accounting in the Orchard

Bar codes—those thick and thin black line patterns that speed our trips through supermarket checkout lines—have quickly endeared themselves to the scientists who inventory quarantined plant stock. According to Bruce J. Parliman, a horticulturist at the USDA-ARS National Plant Germplasm Quarantine Center in Glenn Dale, MD, bar-coded aluminum tags and portable scanners enable his staff to gather data faster and more accurately than ever before.

Hundreds of imported plants are in quarantine today awaiting approval for use in plant breeding work or commercial production. But first ARS scientists must prove these plants pose no threat to American agriculture. While they await clearance, they are tracked on a computer network that will soon hold all the nation's plant quarantine data.

In years gone by, maintaining records on these plants presented a staggering burden. With thousands of entries to be handwritten, error-free information seemed impossible. For if a worker in the field miscopied even a single number, the database for an entire orchard might easily be

TIM McCABE

Horticulturist Helen-Jean Talbott scans a bar code used to identify a black currant plant at the National Plant Germplasm Quarantine Center in Glenn Dale, MD. (1286X1341-8)

distorted. Worse still, plants with questionable data might need to be destroyed.

These days, when horticulturist Helen-Jean Talbott at the Glenn Dale center wishes to add data, she merely slings her scanning equipment over her shoulder and heads for the orchard. The scanner resembles a toy spacegun and is attached by cable to a notebook-sized hand-held computer that has a miniature keyboard.

Today's data-collecting rounds begin at the foot of a tiny pear tree, one of many hundreds of similar young trees in a large orchard. Talbott kneels; it takes just a second to locate the tree's bar-coded aluminum tag and to aim the scanner's lightgun. Beep! Now that the hand-held computer has recorded the tree's identification, she keys in some comments about the tree's current condition. And on to the next tree.

Back at the office, she "dumps" the updated information into a larger computer. In that way, the system constantly knows the whereabouts and what-abouts of the nation's entire stock of quarantined plants. A full or partial report is as readily accessible as a video-display screen or printer.

If an individual plant successfully passes the quarantine process, it may someday become available in your local nursery. Until then, however, its progress during quarantine will be carefully monitored by this innovative means.—By **Regina Wiggen**, ARS.

Bruce J. Parliman and Helen-Jean Talbott are at the USDA-ARS National Plant Germplasm Quarantine Center, 11601 George Palmer Hwy., Glenn Dale, MD 20769. ♦

"Hay-podermic" Safeguards Livestock

Farm animals and their owners could be safer with a new method of keeping hay from spoiling, reports a U.S. Department of Agriculture scientist. He devised a syringe system that prevents the waste of chemical preservative by automatically injecting the right amount into each bale.

C. Alan Rotz, agricultural engineer with USDA's Agricultural Research Service, in East Lansing, MI, developed and patented the system in conjunction with Michigan State University engineers.

Hay is preserved when a foot-long syringe injects anhydrous ammonia or propionic acid into each bale just after it's formed.

The syringe, powered by a tractor's hydraulic system, draws the preservative from a tank mounted on the tractor-pulled baler.

Rotz says the new system reduces hazards of the preservatives—anhydrous ammonia or propionic acid. Both can cause severe skin and eye irritation if handled improperly. Too much ammonia can make animals sick, and propionic acid can rust the baler.

"This system will also allow a farmer to bale when the hay is still damp, without worrying about spoilage or about the leaf loss that occurs if hay is too dry when baled. Dry leaves tend to shatter and fall out of the bale, so baling when the leaves are damp retains more leaves—and more nutrients," he says.

He's proved the system works with ammonia and is testing it with propionic acid, preferred by nearly all hay growers who use a preservative.

Propionic acid is easier and less hazardous to work with than ammonia, Rotz says. "Farmers now spray the acid on as the baler picks the hay up, so it gives a good, even distribution—but it rusts the baler."

The new system eliminates the problem, since the acid is injected right into the bales and none gets on the baler itself.

"Farmers who use ammonia preservative often apply too much," he says. "They usually apply it through a hose into the center of a stack sealed with a plastic wrap. Some bales can get too much ammonia, and others don't get enough."

Rotz says many farmers who once used ammonia stopped when they found it could make their animals sick—causing convulsions, hyperactivity, and even death. He cites agency research findings that sheep and dairy cows can have severe reactions to hay containing more than 3 percent, dry weight, of ammonia.—By **Linda Cooke**, ARS.

C. Alan Rotz is at the U.S. Dairy Forage Research Center, Michigan State University, East Lansing, MI 48824. ♦

Resetting a Sheep's Biological Clock

If you've had a hard time finding lamb chops at your meat counter from February to August, there's a good reason: It's the sheep's fault.

Fresh lamb could be available all year round—even at Easter, say USDA's Agricultural Research Service scientists at Dubois, ID, but that may involve resetting the biological clocks of sheep.

Left to their own devices, sheep normally mate in the fall and produce lambs in the spring. The following fall, these lambs—now fattened to about 120 pounds—go to market. The result is instant glut: Almost 800 million pounds of lamb hits the market at about the same time, forcing the price of lamb down.

"Cheap lamb is great for consumers during the fall, but they're hurt in the long run if they can't get fresh lamb the rest of the year."

James A. Fitzgerald, Agricultural Research Service, Dubois, ID.

LOWELL GEORGIA

Animal physiologist James A. Fitzgerald with a few of the 5,300 ewes and rams used for research on the U.S. Sheep Experiment Station, Dubois, ID. (0687X553-8)

"Cheap lamb is great for consumers during the fall, but they're hurt in the long run if they can't get fresh lamb the rest of the year," says James A. Fitzgerald, animal physiologist at the Agricultural Research Service's U.S. Sheep Experiment Station.

Low prices for lamb during the main marketing months, August through October, also cut deep into sheep growers' profits, he says. "We hope to produce reasonably priced lamb meat year-round by changing the sheep's breeding times."

Fitzgerald puts it this way, "We need a breeding system that provides range producers with two breeding periods for year round production: During the first period, some ewes would be bred in the fall and lamb in the spring, as happens in nature. In the second, a different group of ewes would be bred in the spring and lamb in the fall."

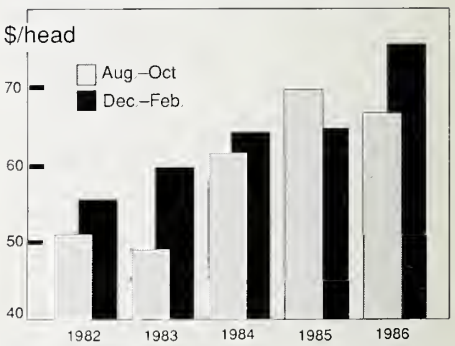
The researchers at Dubois are having considerable success approaching seasonality in different ways. These include experiments with light control and hormones that may fool sheep into thinking it's a different time of year. However, Fitzgerald says, the best approach may be conventional cross-breeding and selection to develop animals that naturally mate out of season. One disadvantage to this method is that it could take 20 years or more.

Hoping for Twins

Dubois scientists are already getting some of the experimental flock to breed out of season: 60 to 65 percent of these ewes lamb and 50 percent bear twins in the off-season. "Our next goal is to get 80 percent of our ewes to produce twins each fall," says Fitzgerald. These prolific ewes will then be used for long-term breeding experiments.

"Although ewes rear twins to somewhat lower weights—mostly because the amount of milk available remains the same—multiple births are obviously a plus," Fitzgerald says. This is because, "It's the total pounds of lamb that go to market that counts."

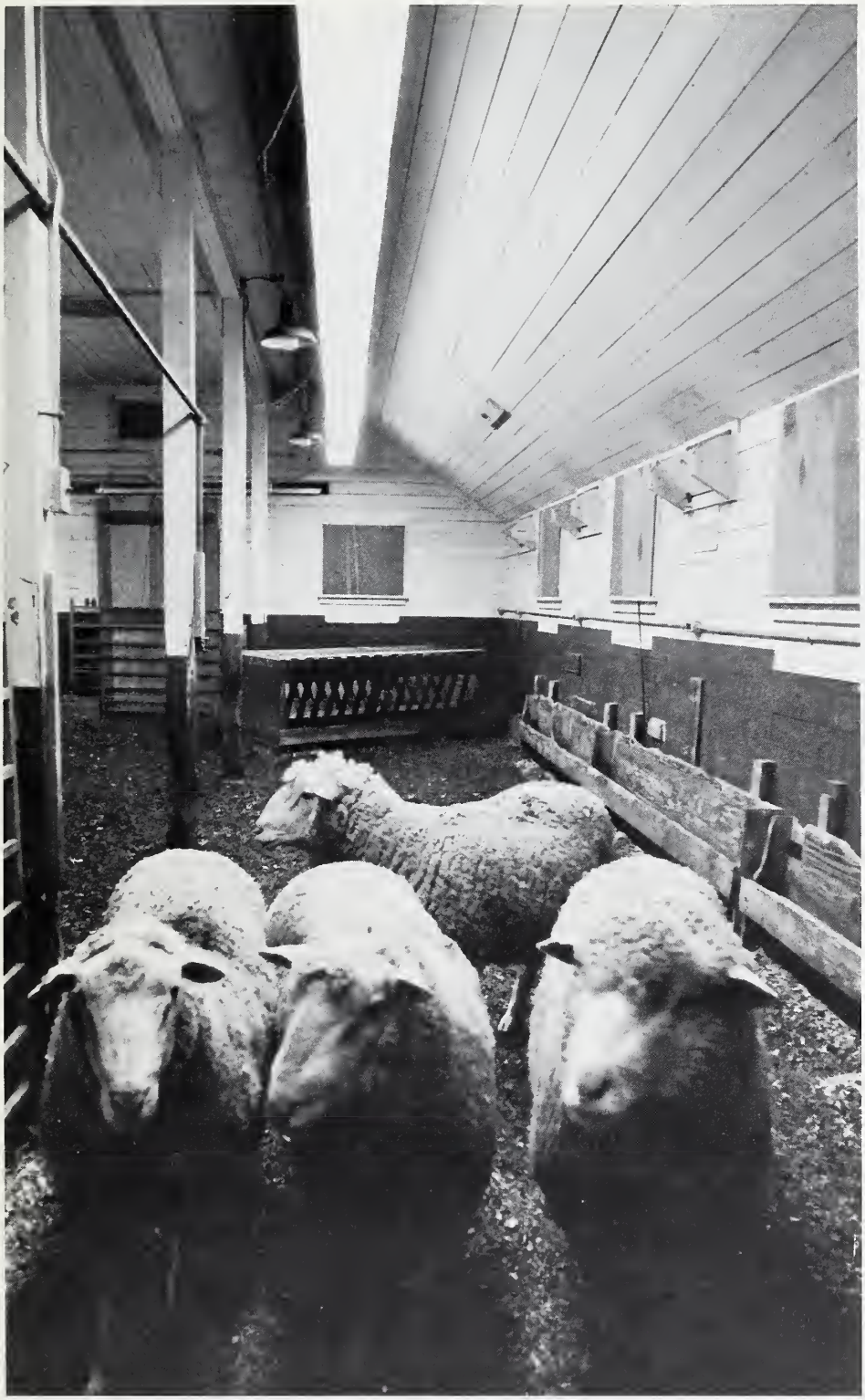
Prices received by U.S. lamb producers during the main marketing period (Aug.-Oct.) compared to off-peak marketings



SOURCE: USDA-NATIONAL AGRICULTURAL STATISTICS SERVICE

Upping Ram Potency

According to Fitzgerald, who is also studying the male side of seasonality, sheep respond sexually to the amount of sunlight they get. In one test of fertility,



LOWELL GEORGIA

In male-fertility studies, rams are exposed to different levels of artificial light. The single light bank is controlled by a timer set for the experiment schedule. (0687X551-7)

50 rams were exposed to different levels of artificial light in a windowless barn—much like "gamblers in a Las Vegas casino where reference to actual time, such as light streaming through a window, is steadfastly avoided."

"As expected," Fitzgerald says, "we found that the rams responded favorably to the shorter days of fall—testes size as well as quantity and quality of sperm increased."

In these studies, Fitzgerald and ARS research associate Jane R. Mole are investigating laboratory methods to measure potential ram fertility under different light schedules. Their semen tests are patterned after clinical assays developed for human reproduction.

They compare ram potency by placing sperm from two rams in the same test tube and seeing which will fertilize a ewe's egg. To distinguish between the rams, sperm samples are treated with different fluorescent stains.

If the tests are successful, sheep producers could use this information to screen and pick the best rams for mating with their ewes. Normally, there's a 10- to 30-percent difference in fertility among rams during the long days of spring and summer, says Fitzgerald.

> ***"We found that the rams responded favorably to the [simulated] shorter days of fall..."***
>
> **James A. Fitzgerald,** Agricultural Research Service, Dubois, ID.

Animal geneticist S. Keith Ercanbrack looks for easily observable evidence that would indicate a ram is highly fertile and sexually active during a normally nonbreeding (out-of-season) period, with the expectation that such sexual characteristics would be transmitted to its female offspring.

He's also trying to improve lamb production by selecting intensively for the total pounds of lamb weaned per ewe per year. This total weight of lamb per

LOWELL GEORGIA

Technician William Gardner compares sperm mobility in an evaluation of rams treated with artificial light for breeding potential. (0687X551-15)

LOWELL GEORGIA

To trigger breeding out of season, a ewe is implanted with synthesized melatonin, a hormone naturally secreted in the brain. (0687X553-23)

ewe is determined by the number born, the quantity and quality of milk the ewe produces, her instinctive mothering skills, her age and breed, and, of course, the lamb's genetic growing ability.

According to Ercanbrack, simply breeding for twins does no good if the ewes lack the overall mothering capability needed to raise sturdy, fast-growing lambs.—By **Howard Sherman,** ARS.

James A. Fitzgerald and S. Keith Ercanbrack are at the USDA-ARS U.S. Sheep Experiment Station, Dubois, ID 83423. ♦

Lights, Hormones, Action

Sheep are not the only animals that respond to light. Most mammals are influenced by daily and seasonal rhythms of light and dark that signal when to eat, sleep, breed, and hibernate.

Even humans are affected by seasonal changes in light. Studies by the National Institutes of Health have shown that increased levels of the hormone melatonin, released by the body during the short days and long nights of fall and winter, may be to blame for the "winter blues"—a condition accompanied by feelings of exhaustion, depression, and irritability.

But the same biological messenger that turns people off can turn other creatures on. In sheep, melatonin triggers breeding, according to animal physiologist John N. Stellflug at the U.S. Sheep Experiment Station, Dubois, ID. His studies of female seasonality indicate that this hormone, secreted by the brain, "tells" the ewe when it's time to mate.

"Ewes normally breed in the short days of fall," he says. "So when they receive additional melatonin, it simulates the effect of a shortened day. For example, ewes receiving the hormone in spring will become ready to breed despite the lengthening days."

Sheep may be fed a diet high in melatonin, or they can receive an experimental melatonin implant that slowly dissolves over 6 weeks. The implant will not be available for commercial use until it is approved by the Food and Drug Administration.—**H.S.**

A Dairy Program That Helps Everybody

Two-fifths of all dairy herds in the United States are in the National Cooperative Dairy Herd Improvement Program. ©Grant Heilman Photography

Judged by nearly any criterion, the National Cooperative Dairy Herd Improvement (DHI) Program is an unqualified success.

Evolving from a dairy farmer's proposal in 1905, the DHI program is based on the principle that complete and accurate records are requisite to a profitable dairy operation.

The program benefits the dairy industry in several ways. For dairy farmers, who pick up the tab for more than 90 percent of the program's total cost, it provides current information on each animal and on the herd so that they can manage their operations more efficiently. It helps the family dairy farmer as well as the large operator.

One such farming couple is Marlin and Kathleen Hoff, of Carroll County, MD, who own and operate one of the 60,000 U.S. dairy farms now participating in the program. Once a month, Dawn Raver, one of 2,500 Dairy Herd Improvement Association (DHIA) supervisors in the nation, arrives unannounced at the Hoff farm and heads for the dairy barns. During her visit, Raver collects detailed information on each of the 300 cows in the Hoff herd, including the date of last breeding or calving. If a cow is milking, she records milk yields in pounds and takes samples at each milking during her visit.

Raver turns the milk samples over to the DHI Central Laboratory in Hagerstown, MD, for determination of butterfat, protein content, and somatic cell count, which gives an indication of udder health. All the data she collects is processed by a computer contractor in Provo, UT, one of nine used by DHIA. The contractor summarizes the data into management information for the Hoffs' herd and promptly mails the couple a copy of the computerized report.

When their report arrives, Marlin Hoff takes down the previous month's report from his office wall, files it away, and tacks up the new one.

"The DHI statistics guide this operation," he says. "They tell me which cows are ready for drying, which are ready for breeding, and which ones will calve soon and start giving milk again. Cows no longer profitable are red-lined on the report so that I can take them off the milking line and sell them."

Hoff says, "like any other management tool, the value of the stats depends on how I use the information. They're a tool to help me find out which cows are paying the bills." For the service, the Hoffs pay about $1.50 per month per cow to their state DHIA.

Is it worth it? Some 40 percent of all dairy farmers in the United States participate in the DHI program today. Records show that the 4.5 million cows in member herds yield from 4,000 to 5,000 more pounds of milk per lactation than cows in nonmember herds. At current milk prices, that means that annual gross income of farmers in the program is $500 to $600 greater per cow, on the average, than that of nonmember farmers. Or, to put it another way, for every dollar a member spends on the program, he or she gets back about $30.

Dairy herd improvement ultimately benefits consumers, too. Because much of the cost of a cow is the feed and labor needed to maintain her, fewer but higher yielding cows mean lower priced milk. More milk per cow is one reason why American consumers today spend only 14.7 percent of their disposable income on food, compared to 16.3 in 1976.

During the last 5 years (1981-86), the retail price of fluid milk has stayed about the same, at $1.11 per half gallon. In the same period, the retail price of all food has risen 13 percent, according to USDA's Economic Research Service.

This price stability for milk reflects in part the steadily improving efficiency on the dairy farm and more milk per cow. The latter is largely the result of improved breeding—another result of the DHI program and possibly its most significant payoff for farmer and consumer. Scientists at USDA's Agricultural Research Service receive the lactation records on all herds enrolled in the program and use the figures to rank the bulls that sire the nation's dairy cows and to rank the cows themselves. These national summaries, which are invaluable for dairy breeding, are sent not only to dairy farmers, but also to companies involved in artificial insemination, to breed associations, to many animal scientists, and to people in 30 foreign countries.

Information in the summaries is also used widely in dairy courses in high schools and universities as well as in the dairy extension education programs.

Frank N. Dickinson, who heads the Agricultural Research Service Animal Improvement Programs Laboratory, in Beltsville, MD, says that a major aim of his group's research "is to use DHI program records to help bring about continuing genetic improvement in bulls and cows." The traits desired in a herd of cows, he says, are those with "economic merit."

TIM McCABE

USDA began using DHIA data for genetics research in 1935. Since then, says Dickinson, procedures have been steadily improving.

Starting in the late 1950's, the calculating power of stored-program digital computers resulted in major breakthroughs in techniques for identifying superior bulls and cows.

One result of the research has been an expanded U.S. export market for live cattle, bull semen, and calf embryos.

ARS scientists also use the DHIA data to improve other important traits of dairy cattle. Examples of recent accomplishments include the development of genetic evaluations for protein and an index for cheese-yield dollars.

"One aim of our current research," Dickinson says, "is to help change the composition of milk so that it contains more protein, making it an even healthier product with less butterfat."

TIM McCABE

Top: After their unannounced arrival at the Hoff dairy farm in Carroll County, MD, DHI supervisors Dawn Raver (left) and Carol Diem collect milk samples for laboratory analysis. (0687X658-32)

Above: In Beltsville, MD, animal geneticist Rex Powell (left) and laboratory director Frank Dickinson review the latest genetic evaluations based on DHI statistics. (0487X324-21)

TIM McCABE

Maryland dairyman Marlin Hoff holds his prize Holstein, Kewpie, in high regard. She's a top milk producer and an example of superior breeding achieved through DHI. (0487X334-3)

Other new research is branching out into genetic evaluations of dairy cattle for reproductive efficiency and resistance to mastitis. Researchers are also identifying conformation traits that contribute to strong, healthy cows with a capacity for longevity. What is wanted are cows that can stand the rigors of high production through many lactations without special treatment.—By **Hubert Kelley** and **Stephen Berberich,** ARS.

Frank N. Dickinson is at the USDA-ARS Animal Improvement Programs Laboratory, Beltsville Agricultural Research Center-East, Beltsville, MD 20705. ♦

The Dairy Herd Improvement Association

An important role in genetically upgrading the nation's dairy cows has been carried out by the National Dairy Herd Improvement Association, with headquarters in Columbus, OH, and its affiliated state DHIA's.

These associations of dairy producers administer the operational aspects of the program in the field. A major contribution is the Quality Certification Program, which provides an umbrella of quality control over DHI field-testing equipment, laboratories, and computer centers. The DHIA's also provide the framework for employing DHIA supervisors; they furnish the contracts and agreements under which the program operates and help enforce official DHI rules.

Helping guide the DHI program is a policy board that includes representatives of USDA's Agricultural Research Service and the Extension Service at the state and federal levels, the National DHIA, the Purebred Dairy Cattle Association, and the National Association of Animal Breeders.

These groups, representing various interests, help ensure that the National Cooperative DHI Program continues to fulfill its primary mission of providing information to participating dairy farmers to help them improve the profitability of their herds.—**H.K.** ♦

New Turkey Vaccine Licensed

Nine firms have obtained licenses to make a patented U.S. Department of Agriculture vaccine against a turkey disease. It is the first federally licensed vaccine against hemorrhagic enteritis, a disease that suppresses a turkey's immune system and may kill up to 20 percent of a producer's young turkeys, says the vaccine's inventor, Keyvan Nazerian of USDA's Agricultural Research Service.

Use of the vaccine could lower the cost of production and lead to lower prices for consumers, says Nazerian, veterinary medical officer at the ARS Regional Poultry Research Laboratory in East Lansing, MI.

Damage costs from hemorrhagic enteritis are unknown. But a report from the American Association of Avian Pathologists cites intestinal disorders, which include hemorrhagic enteritis, as the second most frequent disease problem in turkeys in 1986, after salmonella.

Nazerian says that the new vaccine is safer than locally prepared vaccines producers now use. Those vaccines carry a risk of transmitting other diseases, because they are made by extracting the virus from the spleens of live turkeys. "Producers won't have that risk with the new vaccine," he says.

The new vaccine is made from a form of the virus that is alive but does not cause disease. When it's administered by adding it to turkeys' drinking water, they develop antibodies that will fight off disease-causing forms of the virus.

Hemorrhagic enteritis is characterized by bloody droppings, diarrhea, weakening, and sudden death in 5- to 10-week-old turkeys.

Names and addresses of firms currently licensed to make the vaccine may be obtained by writing to the Coordinator, National Patent Program, USDA-ARS, Room 401, Bldg. 005, Beltsville, MD 20705.—By **Linda Cooke,** ARS.

Keyvan Nazerian is at the USDA-ARS Regional Poultry Research Laboratory, 3606 East Mount Hope Rd., East Lansing, MI 48823. ♦

The Wonder Grass: A Mixed Blessing?

Lush, green, hardy, it covers about 35 million acres, mostly in the southeastern United States. Football fields, golf courses, highway medians and roadsides, pastures, parks, and lawns are graced with it. Kentucky-31 tall fescue is the "wonder grass" that starts easily, adapts to a wide range of soils, tolerates heat and other environmental stresses, and resists insects.

Discovered on a farm in Menifee County, KY, in 1931 (hence, Kentucky-31), this grass was released as a forage variety in the early 1940's and quickly became the most popular cool-season forage grass in the Southeast.

Tall fescue is the only perennial cool-season grass that is long lived and high yielding and can be grown in much of the transition zone between cool and warm humid regions, from the Piedmont Region on the Atlantic Coast to eastern Kansas and Oklahoma, and from mid-Georgia to southern Ohio.

But it can make cattle sick. "Crude protein, digestibility, and mineral analyses indicated that tall fescue is a high-quality forage grass," says John A. Stuedemann, an animal nutritionist with the USDA Agricultural Research Service at Watkinsville, GA. "So it was puzzling that animals grazing it lost weight and showed other visible disorders."

Cattle grazing tall fescue can be affected by:

- Fescue foot—a gangrenous condition of the feet, ear tips, and tail.
- Fat necrosis—hard masses of abdominal fat that cause digestive upset and calving problems.
- Summer fescue toxicosis or "summer syndrome"—poor weight gains, changes in appearance (shaggy-rough hair coat, excessive salivation, nervousness), intolerance of heat, reduced pregnancy rate, and lower milk production.

Signs of these abnormalities can appear as early as 10 days after an animal has grazed tall fescue.

"At first it was thought that poor performance of cattle on Kentucky-31 might be due to chemicals produced by the plant," says Robert C. Buckner, recently retired agronomist from the ARS Forage Research Unit, Lexington, KY.

ELLEN FITZGERALD

Grazing endophyte-infected tall fescue caused an unhealthy, rough coat and other disorders in this test steer at Watkinsville, GA. (0687X579-28A)

In 1977, Charles W. Bacon, James K. Porter, and Joe D. Robbins (Athens, GA), working with Buckner, discovered that the grass was infected with a fungus that cannot be detected without a microscope. Plant pathologists estimate that 97 percent of the tall fescue acreage is infected at a level considered toxic.

Porter, Bacon, and colleagues first isolated ergot alkaloids (a class of mycotoxins known to produce some of the symptoms associated with fescue toxicosis) from the fungus grown in laboratory cultures.

Later Bacon, P.C. Lyons at the University of Georgia, and Ronald D. Plattner at the USDA-ARS Northern Regional Research Center, Peoria, IL, isolated the alkaloids from infected fescue samples. Shelly Yates and colleagues at Peoria subsequently found them in infected pastures.

"All these compounds have yet to be identified. When they are, then we can determine which are poisonous to cattle," says Yates.

The fungus, *Acremonium coenophialum,* is an endophyte (lives within the plant) and forms a symbiotic, or mutually beneficial, relationship with the fescue. Living between the cells of the grass, the fungus does not appear to interfere with the plant's life cycle.

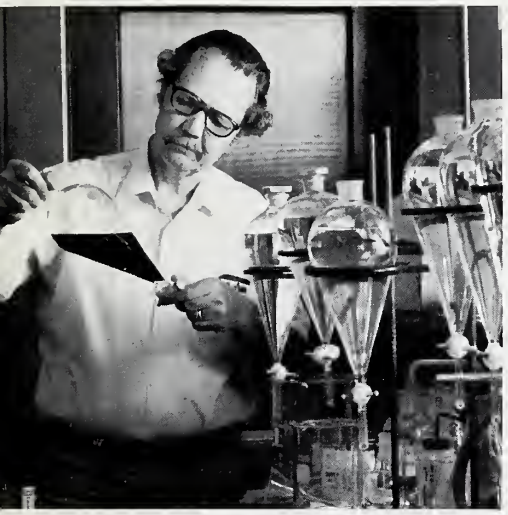
In fact, the fungus could contribute to tall fescue being the hardy, adaptable plant that it is. Research in some areas suggests that improved varieties of tall fescue without the endophyte do not have the longevity of infected grass when grown north of the warm-humid zone.

Also, the fungus seems to be a defense mechanism that prevents overgrazing, as cattle will not graze an infected field as closely as they will one that is endophyte free.

What is ARS doing about this problem that costs cattle producers about $200 million annually?

Buckner and his colleagues developed Johnstone and Kenhy, two varieties of tall fescue that are superior in nutritional value and virtually free of the endophyte; both are available to farmers.

Four years of yield-performance tests in Kentucky showed no differences in longevity of stands and in yields of dry matter between these varieties and



BRUCE FRITZ

DOROTHY HINTON

Top: In Peoria, IL, chemist Shelly Yates separates tall fescue components to identify toxins. (0487X380-26)

Above: Wavy strands of fungus are clearly visible in this infected fescue leaf. Magnified about 250 times. (PN-7251)

infected tall fescue. In Kentucky, cattle fed Johnstone and Kenhy had pregnancy rates, average daily gains, and milk production as good as, or superior to, cattle fed other forages.

In a 12-week experiment at North Carolina State University, cattle performance was not significantly different for two groups of Holsteins when one grazed Johnstone and the other was fed corn silage.

This research indicates that a solution to fescue toxicosis is to plant endophyte-free tall fescue seed.

Some producers are replanting their infected fields with Kenhy and Johnstone; however, it takes time to reestablish complete fields. Given farmers' current financial situation, few can afford to wipe out existing stands and replace them with endophyte-free seed.

Interplanting existing tall fescue with adapted legumes, along with improved pasture management, offers maximum profit potential on fewer acres. Although legumes with tall fescue may cut down on cattle weight loss, they would not completely solve the problem of toxicity. Then too, many legumes are shallow rooted and don't grow well in some soils.

From Oregon where more than 90 percent of certified tall fescue seed is produced, Ronald E. Welty (an ARS plant pathologist at Corvallis) says that although storing the seed at room temperature for 2 years or more reduces endophyte viability, temperatures and moisture necessary to maintain high seed germination also maintain the endophyte. "This means that conditions which kill the endophyte quickest also reduce the seed's ability to germinate," Welty says. "Therefore, the safest measure is to sow endophyte-free seed."

Research at Beltsville, MD, by James Bond and Douglas Bolt has shown that a reduced level of blood prolactin (a hormone known to stimulate mammary gland development and milk production in lab animals) is an early symptom of fescue toxicosis. In a 1982 study, sheep fed infected fescue showed dramatically reduced blood prolactin within 24 hours.

Scientists at the Richard B. Russell Research Center, Athens, GA, are working with two drugs that show promising results. James K. Porter and colleagues orally dosed rats with an extract from fungus-infected grass, stimulating reduced prolactin levels.

The drugs metoclopramide and quipazine, administered together, protected the rats from ergot alkaloid suppression of prolactin. These drugs work on the brain's neurotransmitters, which control hormone levels and normal stability.

Scientists at the Watkinsville and Athens research locations, in collaboration with the University of Georgia School of Veterinary Medicine, are now conducting a similar study with cattle. Half were fed infected fescue and the other half, endophyte-free. The animals have been slaughtered; their brains will be studied to analyze the effects of fescue-endophyte toxins on prolactin levels and brain neurotransmitters.

This research points to possible treatment or prevention of fescue toxicosis.

Meanwhile, scientists at the ARS Northern Regional Research Laboratory in Peoria, IL, are working to isolate, identify, and analyze the toxins produced by the plant-endophyte relationship.

A combination of genetic approaches may someday produce an ideal plant, hardy and nontoxic. Or a drug may be developed that will provide immunity to the toxins.

However, further research is necessary to eliminate the "mixed" part of the blessing in tall fescue.—By **Doris Sanchez,** ARS.

John A. Stuedemann is in USDA-ARS Forage/Livestock Management Systems Research, Southern Piedmont Conservation Laboratory, P.O. Box 555, Watkinsville, GA 30677. Charles W. Bacon and James K. Porter are in USDA-ARS Toxicology and Biological Constituents Research at the Richard B. Russell Agricultural Research Center, P.O. Box 5677, Athens, GA 30613. ♦

Single copies of **Johnstone Tall Fescue, Special Report 1-85** are available without charge while supplies last. This publication, prepared by Agricultural Research Service and University of Kentucky scientists, details the origin and development of Johnstone tall fescue. Johnstone is endophyte-free with improved palatability and digestibility.

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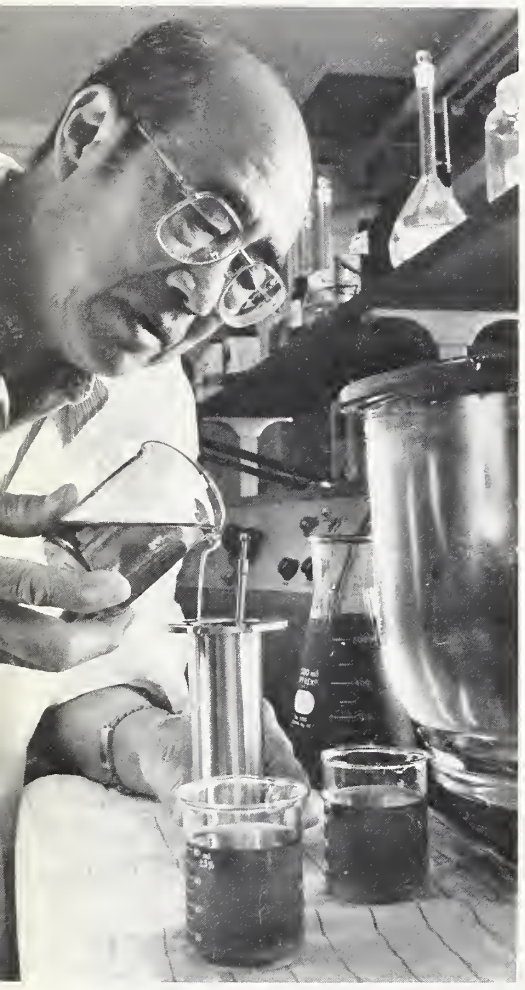
Clear Juice May Boost Apricot's Uses



TIM McCABE

In Albany, CA, food technologist Kent C. Ng prepares enzyme-treated apricot juice for viscosity testing. (0787X722-6)

Clear fruit juice is rarely made from apricots, but USDA's Agricultural Research Service scientists have a new way to do it that could increase the fruit's use in beverages and foods.

Among food processors, the clear apricot juice should be easier to use than thick, cloudy nectar when added to soft drinks, fruit drinks, and products such as frozen juice bars, says Charles C. Huxsoll.

Huxsoll, and colleagues Keng C. Ng and Marcus R. Hart, adapted food-processing techniques—relying on enzymes and ceramic filters—to eliminate the apricot pulp and produce a liquid that isn't cloudy.

Until now, there was no practical or economic way to produce a clear apricot juice, say the scientists, who are based at the ARS Processing and Conversion Research lab in Albany, CA.

Apricot's potential new uses could increase the fruit's retail value by $15 million, according to Leslie A. Rose of the Apricot Producers of California. Almost all of the U.S. apricot harvest is from that state, where in a good year the crop can be worth up to $37 million to growers and have a retail value of $126 million.

Huxsoll says the new process is "probably the most simple and least expensive yet devised to produce a clear apricot juice, as opposed to a thick nectar."

Juice is extracted from pulpy concentrate by using a special blend of different commercially available enzymes, known as macerating enzymes. Very small amounts of these natural chemicals quickly break down the concentrate into liquid and some pulp residue. Passing this mixture through a porous ceramic filter separates the clear juice from the leftover pulp ingredients.

Enzymes have long been used in food processing, but some of those needed for the juice product have only recently become available at a reasonable cost. The ceramic filters are a new development during the past few years.

Because of its natural sugar-acid balance, the juice is probably best suited as an ingredient, he says.—By **Marcia Wood**, ARS.

Charles C. Huxsoll is in USDA-ARS Processing and Conversion Research, Western Regional Research Center, 800 Buchanan St., Albany, CA 94710. ♦

Yeast May Add Value to Farm Commodities

Scientists working on fermentation research have found several colored strains of the yeast *Aureobasidium pullulans* that promise more than just visual relief from the usual off-white to black of this species. The bright red, yellow, orange, and purple strains stand out as potential workhorses for putting surplus farm commodities to industrial use, say geneticist Timothy D. Leathers and coresearchers at the Agricultural Research Service's Northern Regional Research Center, Peoria, IL.

Leathers hopes current studies will help them better understand how enzymes in the color-variant yeast excel at breaking the sugar xylose away from xylan, a component of plant fiber.

Xylose, a five-carbon sugar, is prevalent in brans milled from grains and in a variety of food-processing wastes and makes up to 25 percent of the 500 million tons of annual crop residues in the United States. It is also found in paper-milling wastes.

Abundant supplies of xylose, made available by enzyme treatment of fibrous wastes, could be converted into ethyl alcohol and chemicals used in making pharmaceuticals, pesticides, foam insulation, and industrial resins. It could also be fermented to single-cell proteins for animal feed.

Color-variant strains of *A. pullulans* may produce hundreds of times more enzyme (xylanase) in liquid culture than their dull gray cousins or other xylan-digesting yeasts. Moreover, xylanases from the color variants generally work faster.

The scientists have found that certain sugars such as xylobiose and arabinose can enhance the yeast's production of enzymes. Glucose, another sugar produced by microbial breakdown of plant fiber, represses xylanase production.

Scientists may eventually overcome this stumbling block. Already, they have begun exposing *A. pullulans* to ultraviolet light, in the hope of eliciting

desired mutations—new strains of the organism that are less vulnerable to glucose repression.

Enzymes from other yeasts may someday be teamed up with xylanase from *A. pullulans* in genetically engineered micro-organisms. These specially designed "bugs" may produce high yields of chemicals and fuels from glucose and other sugars such as xylose, says Rodney J. Bothast, leader of the Center's fermentation biochemistry research.—By **Ben Hardin,** ARS.

Timothy D. Leathers and Rodney J. Bothast are in USDA-ARS Fermentation Biochemistry Research, Northern Regional Research Center, 1815 North University St., Peoria, IL 61604. ♦

Geneticist Paul Bolen uses a high-pressure liquid chromatograph (HPLC) to purify enzymes for xylose fermentation. (0487X375-36)

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PATENTS

Changing Fats and Oils Into Higher Value Products

Fatty acids and glycerol are important industrial ingredients—raw materials for a host of everyday products such as cosmetics, drugs, inks, lubricants, and tires.

Old, spent animal fats and vegetable and fish oils, on the other hand, are pretty useless commodities.

There's a way to convert these used or low-value substances into clear, odorless ingredients that can be profitably sold. It's a process called hydrolysis, and ARS scientists are patenting ways to improve it.

Current heat-processing hydrolysis methods require huge steel vessels and costly heating equipment, and they risk polluting the environment. The product may still smell so bad that secondary deodorizing is a must. And despite all this effort, the product's purity may limit its use to soapmaking.

But a new, "cold" method puts the enzyme lipase to work as a catalyst in the chemical process. With this innovation, fats and oils may be hydrolyzed at less expense, and without polluting the environment. Best of all, the product is odor free and considerably purer.

Originally demonstrated in small laboratory batches, the lipase process became feasible for large-scale production with the invention of a mixing device. The ARS-patented device contains a continuous array of baffles that control the turbulence of the swirling chemicals. With this mixer, hydrolysis is relatively simple and easy, enabling systematic, continuous processing.

For technical information, contact Samuel Serota, USDA-ARS, Eastern Regional Research Center, 600 East Mermaid Lane, Philadelphia, PA 19118. *Patent Application Serial No. 06/882,103, "Lipolytic Splitting of Fats and Oils."* ♦

A New Wrinkle-Resistant Fabric Finish

An ARS-patented, formaldehyde-free fabric finish promises wrinkle-resistance without the shortcomings associated with current "permanent-press" processes.

Consumers were grateful, a generation ago, when the first wrinkle-resistant fabric finishes unchained them from the ironing board. However, at least two drawbacks soon became apparent: fabrics treated with these finishes release minute quantities of formaldehyde which can accumulate in clothing factories and warehouses. Also, when the fabrics are laundered with chlorine bleach, they tend to be weakened when touched up by a hot iron.

Formaldehyde can be identified by its characteristic "plastic" odor on new clothing before laundering.

In the new experimental process, wrinkle resistance has been imparted to fabrics comprised of pure cotton or cotton/polyester blends.

For technical information, contact Leon H. Chance or Gary F. Danna, USDA-ARS Southern Regional Research Center, 1100 Robert E. Lee Blvd., P.O. Box 19687, New Orleans, LA 70179. *Patent Application Serial No. 07/050,436, "Wrinkle Resistant Fabric Produced by Crosslinking Cellulosic Materials With Acetals of Glyceraldehyde."* ♦

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